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REMARKS/ARGUMENTS

In the Office Action dated March 1, 2004, Claims 1-8 are pending. Claims 1, 2, 6, and 7 are rejected under 35 U.S.C. § 103(a) as being unpatentable over "Neural Network-Based Control for the Fiber Placement Composite Manufacturing Process" (hereinafter "Lichtenwalner") and U.S. Patent No. 5,886,313 to Krause. Claims 2, 4, 5, and 6 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Lichtenwalner and Krause as applied to Claim 1 and further in view of U.S. Patent No. 5,562,788 to Kitson. Claim 8 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Lichtenwalner and Krause as applied to Claim 1 and further in view of U.S. Patent No. 5,066,032 to Albers. Claim 3 is objected to as being dependent on a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim.

Applicant respectfully traverses each of the rejections. In particular, Applicant submits that none of the cited references teaches or describes a method of forming a composite article including "irradiating at least one fiber tape with a laser diode array," as recited in Claim 1. Further, as discussed below, none of the references provides a motivation for combining the laser diode array of the Krause device with the fiber placement process discussed by Lichtenwalner, and therefore the claimed invention is not made obvious by the cited references.

The Examiner has recognized that Lichtenwalner does not disclose a laser diode array, but he asserts that it would have been obvious to a person of ordinary skill in the art to use a laser diode as disclosed by Krause in the Lichtenwalner process. Applicant respectfully disagrees and submits that no motivation existed for such a combination.

Lichtenwalner is directed to a neural network-based control for a fiber placement composite manufacturing process. Lichtenwalner describes fiber placement as:

a relatively new process that has evolved from two other automated composite fabrication processes: filament winding and tape laying. Similar to filament winding, fiber placement uses multiple tows of continuous composite material. . . . Combining the features of tape laying and filament winding yields a process that can produce shapes that are too complex for either filament winding or tape laying alone.

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Page 687, Section 2. Thus, Lichtenwalner describes a fabrication process in which fibers are placed. The Examiner has noted that Applicants have used the term "tape" to refer to both tapes and tows, but there is no indication that Lichtenwalner is directed to the placement of anything besides fibers. Indeed, Lichtenwalner specifically states that tape laying cannot produce complex shapes that can be produced with fiber placement. See Page 688, Section 2.

Krause, on the other hand, describes a laser diode array as an alternative to conventional laser bonding devices that require technical measures for distributing the laser light uniformly over a wide joint. Krause is directed to the bonding of metal layers in which such "bonding of metal layers must be performed without local melting of the surfaces of the two material surfaces to be joined. This imposes extreme demands on the homogeneity of the power density distribution at the joint." Col. 2, lines 29 to 33. Krause explains that "[i]n CO₂ lasers, homogenization is produced by beam-forming optics and/or vibrating mirrors. . . . If metal plates more than 1 meter wide are to be joined by bonding, a considerable technical and equipment cost is also required that entails correspondingly high costs to achieve homogenization of the power density distribution at the joining point of the two surfaces." Col. 2, lines 33 to 42.

Lichtenwalner, on the other hand, does not describe any requirement for such uniformity in the distribution of laser light for the fiber placement operation. In fact, while Krause states that metal layers must be bonded without local melting, Lichtenwalner specifically identifies the heated composite material as defining a "melt region" and a "polymer melt pool." See Fig. 1. While the temperature of the composite material may be important for placement according to the process described by Lichtenwalner, there is no teaching of any particular requirement for uniformity in energy distribution or heating, only that an appropriate temperature is achieved at the nip point. Lichtenwalner does not describe any particular temperature threshold to which the fiber or polymer materials are sensitive and which would require careful uniformity in energy distribution. Thus, Lichtenwalner does not describe the requirement for the local control of temperature in composite manufacturing that required uniform distribution of light in the metal bonding of Krause.

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Moreover, Lichtenwalner does not describe the heating of wide joints, as described by Krause, or any other requirement for the wide distribution of light. In fact, while Krause describes wide metal joints, e.g., joints having a width of 1 meter, Lichtenwalner is directed to the placement of composite fibers, which are typically narrow. Indeed, Lichtenwalner distinguishes the fibers even from composite tapes, stating that fiber placement can produce shapes that are too complex for tape laying. Presumably, such complex shapes can be produced, at least in part, for the very reason that the fibers are narrow, i.e., narrower than conventional composite tapes.

Thus, Applicant submits that no motivation exists for the combination of Krause and Lichtenwalner. The Examiner has asserted that Krause discloses motivations of long lifetime, low maintenance costs, and improved heating efficiencies. Applicant submits that while such advantages may apply to the use of a laser diode array in place of a laser used in the conventional metal bonding systems described by Krause, such advantages do not necessarily apply to the use of a laser diode array in the process described by Lichtenwalner. Indeed, some or all of these advantages are likely derived as a result of the requirement for uniformity and distribution of laser light in conventional metal bonding systems, as described above. Lichtenwalner does not describe such requirements, as set forth above, and therefore it is unclear whether any of the advantages that the Examiner suggests could even apply to a laser diode array employed in a process such as that of Lichtenwalner. Further, neither Lichtenwalner nor Krause addresses whether a laser diode array would meet the technical requirements of the process described by Lichtenwalner.

For the foregoing reasons, Applicant asserts that Claim 1 is patentable over Lichtenwalner and Krause. Accordingly, dependent Claims 2, 4-8 are also patentable for at least the same reasons.

Further, Applicant separately addresses the rejections of dependent Claims 2, 4, and 7 as being unpatentable over Lichtenwalner and Krause. Claim 2 recites that "inspecting the fiber tape comprises inspecting images of the fiber tape after the fiber tape has been compacted." The Examiner has asserted that "Lichtenwalner discloses inspecting the fiber tape by inspecting images with a focused infrared camera monitors an image of the fiber tape at the point of

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bonding, i.e., past the compaction region (see page 687 and 688, especially section 2).” Office Action, page 4. Lichtenwalner states that the neural network temperature control system includes an infrared temperature sensor, but Applicant finds no teaching in Lichtenwalner that suggests that the infrared temperature sensor monitors a point after the fiber tape has been compacted. In fact, Lichtenwalner cites the importance of the temperature at the nip point. (“Temperature and pressure at the nip point are key process variables to be controlled to ensure successful *in situ* consolidation.” Lichtenwalner, page 688, section 2.)

Claim 4 recites “detecting the tack of the resin of the fiber tape before compacting the fiber tape against the workpiece.” Neither of the cited references discloses detecting the tack of the resin of the tape and, especially, before the tape is compacted against the workpiece, as claimed.

Claim 7 recites “measuring the temperature in a plurality of sensing zones on at least one of the fiber tape and the workpiece; and automatically and independently irradiating a plurality of irradiation zones in accordance with the measured temperature.” The Examiner has asserted that “Lichtenwalner discloses a temperature sensor and controlling the last heat source based on the temperature sensed at the nip point, i.e., at both the fiber tape and workpiece. Lichtenwalner does not disclose controlling individual diodes in the laser array. However, Krause discloses using a laser diode array. Furthermore, one would appreciate that it would have been well known and conventional to utilize individual control of each diode [to] allow for closer tailoring of the temperature profile across the workpiece and tape and improve bonding.” Applicant respectfully disagrees. The cited references provide no suggestion that it was well known and conventional to utilize individual control of diodes in the claimed manner. Further, even to the extent that such a teaching exists in the art, the references provide no motivation to combine such a teaching with Lichtenwalner, which is directed to the placement of narrow fibers.

With regard to the rejections based on Lichtenwalner and Krause in view Kitson and Albers, Applicant submits that neither Kitson nor Albers describes a method of forming a composite article including “irradiating at least one fiber tape with a laser diode array,” as recited in Claim 1. Further, neither Kitson nor Albers provides any motivation for combining the laser diode array of the Krause device with the fiber placement process discussed by Lichtenwalner.

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Therefore, the invention of Claim 1 is patentable for the reasons set forth above notwithstanding Kitson and Albers, and each of the dependent Claims 2 and 4-8 is also patentable.

Finally, regarding allowed Claim 3, Applicant has cancelled Claim 3 and incorporated the limitations thereof in new Claim 9, which also includes each of the limitations of Claim 1. Accordingly, Applicant submits that Claim 9 is allowable. Claims 10-15, which correspond to Claims 2 and 4-8, are dependent on Claim 9 and therefore also allowable.

For the foregoing reasons, Applicant submits that Claims 1-2 and 4-15 are allowable.

* * * *

CONCLUSIONS

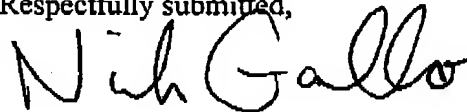
In view of the remarks presented above, Applicant submits that the present application is in condition for allowance. As such, the issuance of a Notice of Allowance is therefore respectfully requested. In order to expedite the examination of the present application, the Examiner is encouraged to contact Applicant's undersigned attorney in order to resolve any remaining issues.

It is not believed that extensions of time or fees for net addition of claims are required, beyond those that may otherwise be provided for in documents accompanying this paper.

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However, in the event that additional extensions of time are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 CFR § 1.136(a), and any fee required therefore (including fees for net addition of claims) is hereby authorized to be charged to Deposit Account No. 16-0605.

Respectfully submitted,




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May 14, 2004
Date

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